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**An Overview of Climate Change:
What does it mean for our way of life?
What is the best future we can hope for?**

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Abstract

This paper starts with the question of whether climate change will require a significant reduction of consumption among the richer people in the world, and ends with the most optimistic picture the author can conjure up, of the world in the year 2075. That hopeful picture is of a world in which inequalities – among and within nations – have been substantially reduced. The challenges and adjustments confronting humanity in the coming decades provide an opportunity that could be used to mitigate climate change in ways that can improve the circumstances of the poor. Ecological reasons to reduce throughput of energy and materials in economic systems urge the abandonment of high-consumption life-styles. The 21st century will be an era of many losses, but it is conceivable that societies will successfully make the transition from goals of economic growth, as understood in the 20th century, to goals of maintaining and increasing sustainable well-being.

An Overview of Climate Change: What does it mean for our way of life? What is the best future we can hope for?

Neva Goodwin ¹

1. Introduction

This paper addresses a question that is often in the back of people's minds when, in the wealthy countries, there is discussion about climate change. This question, which is more often dodged than addressed, is: **will we in the rich countries need to rearrange our lives so as to make do with significantly less consumption?** Put another way: will the reality of climate change require people in the rich nations to live in ways that greatly reduce the economy's throughput of energy and materials? That might mean less long-distance travel for ourselves, and for the things we buy; less meat; smaller houses; and a reduction in the quantities of things that fill most of our houses – sports equipment, toys for our children or grandchildren, gadgets, and so on. Is such a scenario possible – desirable – inevitable – or is it something we simply cannot contemplate?

I am currently writing a book – *Changing Climate, Changing Economy* – that will expand on these issues, and a number of others. This paper is a first attempt to sketch out the scope of the book. Here I will examine the questions posed above in relation to three types of action related to climate change. These are:

- **Mitigation** – efforts to prevent climate change;
- **Adaptation** – responses to climate-related disasters that are not prevented by mitigation efforts; and
- **Resilience** – the characteristic needed in individuals, communities, nations, and the world, to prepare for disasters, to reduce the suffering and loss they bring, and to rebound in positive ways.

The paper will be organized as follows: In section 2 I'll propose a conceptual starting point for understanding the challenge of climate change, and touch on a few facts about it. Section 3 will very briefly describe some encouraging possibilities for mitigation. Section 4 takes on issues relating to the unavoidable effects of climate change that will be faced, in coming decades, by humans around the world. Specifically, this section connects the concepts of climate change adaptation and resilience to existing global inequalities. (An earlier, but similar, version of section 4 appeared in "Economic Vitality in a Transition to Sustainability," my booklet in the series, *Growing the Economy through Global Warming Solutions*; published by the Civil Society Institute, 2007, and available on www.GDAE.org.)

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Section 5 outlines a plan for allocating the costs of mitigation in ways that can reduce global inequalities. Section 6 considers what kinds of assistance will be needed for those most affected – and how, and whether, such assistance might be elicited. Section 7 outlines a “carbon cap and trade” system. Recognizing the economic growth possibilities in the technological response to climate mitigation, this version of cap and trade emphasizes transfers of technology to, and economic development in, the poorer countries.

Section 8 broadens the discussion, from climate change to consideration of two other major issues that are likely to affect the U.S. and the world economy in coming decades: demographic shifts, and recessionary pressures. Section 9 then sums up my answers to date on the question posed at the outset – whether climate change will force people in the rich nations to reduce the amounts of energy and materials flowing through their lives. Section 10 cites some conclusions from the field of hedonic psychology to suggest that these changes do not need to make our lives less happy. Section 11 then jumps ahead to the year 2075, to try to imagine what the world could look like at that time.

2. Climate change: some of what we know, and some ways to think about it

For the last 10,000 years we have been living in a remarkably stable climate that has allowed the whole of human development to take place. In all that time, through the mediaeval warming and the Little Ice Age, there was only a variation of 1°C. Now we see the potential for sudden changes of between 2°C and 6°C. We just don't know what the world is like at those temperatures. We are climbing rapidly out of mankind's safe zone into new territory, and we have no idea if we can live in it. (Robert Corell, Arctic scientist and IPCC member; *The Guardian* 5 October 2007.)

A useful starting point for understanding the economy in its ecological context (and also, in fact, in its social context) is an idea that has not received much attention until recently: the idea of common wealth. It now appears that an important part of the common wealth of all humanity is *the global atmospheric capacity to absorb greenhouse gasses without disastrous climate effects*. Until the industrial revolution this capacity was never noticed, as it was in a balance in which greenhouse gasses emitted as methane, by the release of CO₂ in the decay or burning of trees and plants, and by other natural causes, were offset, principally by new plant growth and by the carbon uptake of the oceans.

This balance has been seriously disturbed by various types of human activity which are rapidly degrading the atmosphere's capacity to absorb greenhouse gasses without disastrous climate effects. Human beings in effect used up this atmospheric capacity decades ago, creating a situation in which some amount of climate change is inevitable, and additional emissions of greenhouse gasses make it more severe.

What are these greenhouse gasses? Methane produced from livestock and paddy rice farming, as well as vented septic systems and landfills, accounts for about 15% of the

anthropogenic effects that are tipping the planet's climate toward warming. (Stern Report, chapter 1.) In a feedback effect, if global warming causes the melting of the permafrost and frozen peat bogs, the release of methane could rise substantially. Nitrous oxide, mostly from fertilizers, accounts for another 6% or so². The largest and best-known cause, at present accounting for nearly three-quarters of climate change, is the release of CO₂ into the atmosphere.

The major source of CO₂ emissions is, as is well known, the combustion of fossil fuels, while deforestation also releases (and reduces the capture of) CO₂, accounting for 15-20% of the climate change that has occurred to date. (Stern, 2007.) Of particular concern is the massive destruction of rain forests in tropical countries, which not only releases carbon that had been stored in living trees – it also reduces the uptake of carbon from the forest biota, both above ground and in the soils. While part of the reason for this destruction can be traced to population growth, with growing demand for land on which to grow food, a larger amount relates to development and trading patterns in which tropical forests are cut down to sell the wood abroad, or to grow crops such as soybeans or cattle (the latter most notably in the Amazon), to earn the foreign currency on which these countries are increasingly dependent.

3. Mitigating climate change – and preserving economic growth?

When people think about what to do about climate change, the first concern, appropriately, is how to prevent it from happening, to the extent possible. Mitigation activities can be divided into two parts: one is conservation; the other is the development and deployment of alternative energy sources. Each of these, again, has two principal components: technology, and behavior change.

Technology is increasingly being seen as a source of economic growth – maybe the start of a new kind of growth that doesn't have negative environmental impacts. The growth model of the past two and a half centuries was one that kept increasing the amount of fossil-fuel-based energy available to people. The new model – one that is not yet fully realized – emphasizes the amounts of energy **services** available to people. Better home design, for example, can increase the energy services of heat and light, while reducing the amount of energy used to produce these services. In the home of Amory Lovins, in Colorado's high mountains, banana trees grow in the enclosed courtyard in the center of a house with no furnace. Lovins, who has minimized energy waste from the sources he taps into, reports that "building such a heat-tight home actually decreased construction costs by \$1,100. Reinvesting that sum, plus an additional \$6,000, saved 99 percent of water-heating costs and 90 percent of household electricity plus 50 percent of water use, repaying the extra expense in 10 months."³

² Global Warming Fact Sheet, at http://www.ypete.org.uk/docs/factsheets/env_facts/glob_warm.html

³ "How to Fuel the Country While Saving the World." *Newsweek* 2007 downloaded Feb 9 2008 at <http://www.newsweek.com/id/80938/page/1>

The behavioral aspects of conservation are not only a matter of **how** you do what you do (e.g., whether the winter thermostat is set at 78 or 63 degrees Fahrenheit); it will also include some changes in **what** is done.

-- For individuals the decisions could include choices between shopping near-by versus going to a distant mall; or decisions on how many square feet of living space one requires.

-- Builders need to decide whether to put in a furnace, or to follow Lovins' lead and use the saved money to build houses that don't require furnaces.

-- Governments face decisions on what kinds of transportation systems to support – more highways vs. more public transit? – as well as decisions on how to allocate the budget, in the famous choice between “guns and butter;” or what kinds of agriculture to subsidize.

-- Corporations may face hard choices about their basic business: should ExxonMobil continue to define itself as a petroleum producer, or should it follow BP and others into calling itself an energy company? How many companies can follow the model of Ray Anderson, who founded a company that sells the **service** of floor covering, not the floor covering itself – which is designed to be taken back and recycled?

It is encouraging that there are known conservation measures that can provide the same energy services with a half or a quarter of the energy. The task ahead is, first, to implement existing conservation technologies; second to develop additional conservation and clean-fuel technologies; and third to speed up the transition to clean fuels. Huge numbers of jobs are already being created in industries that seek to mitigate climate change by energy conservation or the development of energy alternatives, along with related technological innovations. Investment funds are pouring into these industries; some of that money will be lost, but there appear to be good prospects for strong positive returns, on average. I mention this, because it adds to the rosy picture of economic growth continuing, even with an energy transition. Economic growth, measured in money value (corrected for inflation), can increase even if many of the things we are used to having become more expensive, so that we can't have as much of them. I'll return later to this more sobering issue.

4. “Adapting” to climate change

Now, however, I want to address another, less talked-about, aspect of what climate change will require. This aspect is generally referred to as **adaptation**; that means coping with those climate change effects that we cannot, or will not, prevent. The greatest need is to help vulnerable communities and individuals (in both rich and poor countries) to increase their ability to cope with climate-related catastrophes. Two social characteristics, in particular, are increasingly being perceived as essential for adaptation.

- One is *resilience*, which means, among other things, that the least advantaged groups in society must be strengthened, and supportive institutions developed, so that in the face of catastrophes they can adapt instead of being crushed. The disaster of New Orleans, so ill-prepared to respond to Hurricane Katrina, is a dramatic reminder of the importance of resilience.

- The other requirement for successful adaptation – and a prerequisite for resilience – is *social cohesion*, which means that people identify with larger social goals than their own immediate interest. Among the things that are most damaging to social cohesion are wide inequalities. At the time of this writing, income and wealth inequality in the United States are at about their high-water mark for the last hundred years; inequality is also exceptionally high, by recent standards, in many other parts of the world. Most mainstream economic theorists have had little to say about the growth in inequality – in part, no doubt, because the policies supported by their theories have been important in increasing inequality in the last quarter of the 20th century.⁴

Adaptation will be much more difficult for poor, developing countries, which are likely to suffer from droughts and food deficits beyond anything experienced in the last century. The April, 2007 report from the Intergovernmental Panel on Climate Change describes many ways in which poverty, especially in the tropics, spells disastrously low resilience against the likely effects of climate change. The international community will face myriad regional conflicts over increasingly scarce resources of fresh water or arable land. The concept of “environmental refugees,” familiar now to only a few people, will become part of the common language.⁵

Fourteen years ago I wrote a paper describing a “nightmare scenario” in which I imagined that

redistribution does not occur; ecological collapse hits the poor soonest and hardest, causing Third World famine and disease on a scale surpassing anything ever experienced by our species; and the wealthy countries learn enough from that to reform their ways – not in terms of helping the poor, but in reducing their own throughput. (Goodwin, 1994.)

What I left out of this nightmare scenario was the “gated community” aspect that is already appearing within countries, and on their borders, as individuals, communities and nations consciously or unconsciously lay the groundwork for the use of violence by the rich to repel a possibly violent influx of the desperate.

Equality is a requirement for resilience on the global as well as local level. As people in poor nations become increasingly unable to feed themselves, to preserve their homes, or to maintain their livelihoods, the rich nations and people of the world face a stark choice:

⁴ These policies have included “trickle-down economics,” “supply-side economics,” and “the Washington consensus.” Regarding the last of these – a set of principles imposed by the World Bank and the IMF on poor countries – it is interesting to note which of its prescriptions have been adopted in the U.S.: privatization of public services, tax reduction, welcoming foreign investment, and secure property rights – vs. which prescriptions the U.S. has ignored, while urging them on other countries: fiscal discipline and reduction of government borrowing, and dismantling trade barriers and trade subsidies.

⁵ According to the report, “An Uncertain Future: Law Enforcement, National Security and Climate Change,” it is “almost certain” that, by 2050, droughts, food shortages and flooding caused by climate change would lead to the mass movement of up to 200 million environmental refugees. (The Environmental and Energy Study Institute, www.eesi.org; February 2, 2008.)

to give the assistance required to increase resilience among the poor – or to let them die, or shoot them when they arrive at the gates. If morality is not sufficient to make the choice obvious, there is also the consideration of how unpleasant it would be – even for the rich – to live in a such a world.

5. Convergence toward a low level of fossil fuel use, as a step toward global equity

Do we have any alternative? We will not find one in business-as-usual, supported by economic theory. When I was in graduate school a teacher introduced a class by saying, “Economics is supposed to be about equity and efficiency. We’ve never figured out how to deal with equity, so for the rest of the class we’ll focus on efficiency.” That focus, and that omission, was in force for the rest of my formal education as an economist.

However the ideology that allowed this choice, and this division, is increasingly called into question by the results of the policies it has driven. As noted by an especially effective critic of recent decades’ economic development orthodoxy, “Neoclassical free-trade free-market policy claims to sacrifice equity for growth, but in fact it achieves neither; growth has slowed down in the past two and a half decades when markets were freed and borders opened.” (Chang, 2007, p. 17.) This point about the effectiveness of a growth-rather-than equity approach applies to rich countries as well as to poor ones (as laid out in the book just cited). As is trenchantly stated by the author of *Collapse: How Societies Choose to Fail or Succeed*:

If the whole developing world were suddenly to catch up [with the consumption rate of the U.S. and Western Europe] world rates would increase elevenfold. It would be as if the world population ballooned to 72 billion people (retaining present consumption rates).

Some optimists claim that we could support a world with nine billion people. But I haven’t met anyone crazy enough to claim that we could support 72 billion. Yet we often promise developing countries that if only they will adopt good policies – for example, institute honest government and a free-market economy – they, too, will be able to enjoy a first-world lifestyle. This promise is impossible, a cruel hoax: we are having difficulty supporting a first-world lifestyle even now for only one billion people. (Jared Diamond, “What’s Your Consumption Factor?” *New York Times* op ed, Jan 2, 2008, p. A19)

A United Nations Development Programme report notes, regarding per capita income differentials, that if high income countries were “to stop growing today and Latin America and Sub-Saharan Africa to continue on their current growth trajectories, it would take Latin America until 2177 and Africa until 2236 to catch up.” (UNDP 2006, p. 37.) Even this projection, in which the world must wait more than two centuries for Africa to attain a Western standard of living, sets aside three realities. One is that if the path of economic development continues to encourage all nations to strive for the U.S. level of consumption, as Diamond points out in the passage just quoted, the life support system of the planet will collapse long before the goal is reached. A second is that the

economic impacts of natural disasters are more severe in poor countries, with likely negative impacts on their economic growth. Thirdly, the West has not yet shown any disposition to stand still while the rest catch up. But that last, in some form, is what I am going to propose.

Discussions about mitigating climate change, even in Washington D.C., are beginning to accept, at least in the abstract, a requirement to reduce fossil fuel use by 80% below 1990 levels by the year 2050. It is increasingly hard to dispute that this is the minimum necessary to prevent the global temperature from rising to more than two degrees centigrade above where it was at the beginning of the 20th century – and that more than a 2 degree increase will have horrible consequences. This 80% reduction must be a world-wide requirement. However, if the rich countries achieve this, and no more, then the poor countries must do the same, reducing their fossil fuel use by 80%, even from a much lower starting point.

An 80% reduction fossil fuel use in the United States would bring us down to about the per capita level of fossil fuel use now prevailing in China, Djibouti, Suriname, and Macedonia.⁶ Is it acceptable that those countries must also reduce their use of the currently most convenient fuels, so that they reach a level, 40 years from now, that is still just one-fifth of the U.S.? What about the 115 countries whose per capita level of fossil fuel use is **less** than 20% of the US – including 66 countries, starting with India, who achieve only 5% or less of our per/capita fossil fuel energy use – should that differential also persist into the future? If technology for alternative energy is developed rapidly enough, and is introduced immediately into these countries, so that all can ramp down carbon emissions at the same rate without seriously harming their chances at development, that would be fine. However, this may be seriously unrealistic – even more unrealistic than what I am about to suggest in its place.

A number of thinkers are starting to propose that the only morally conceivable alternative is that the rich countries need to plan that by the year 2050 they will have reduced their CO₂ emissions by **90%**, so as to leave room for the developing countries to slide down a somewhat slower path of CO₂ emissions. The best report I've seen on this – the Global Development Rights Framework, which can be found at www.ecoequity.org – proposes that the developing countries continue a slow increase in fossil fuel use for as much as ten years, while gearing up – with considerable help from the rich countries – for a massive energy transition. They would then reduce their emissions by about 6% a year, while in the rich world's "90% by 2050" scenario (which, by the way, is also Gore's trajectory) the rate of emissions reductions would reach 6.7% annually by 2025. That doesn't look like a great difference – 6% a year in the poor countries vs. 6.7% a year in the rich – but in fact it would lead in the direction of convergence, especially if the rich countries begin to implement their emissions reductions 8 or 9 years earlier, by 2010 or 2011. If this plan were followed, by 2050 the per capita fossil fuel consumption in the rich world, as a whole, would be no more than twice the level of the developing world – a much lower differential than at present.

⁶ Comparative figures from the US Energy Information, Energy Review Annual 2005.

There are many questions, here, about what is realistic – politically, most of all, but also technologically. On the technological side, it is increasingly asserted that conservation can close something like half of the gap between the current rate of fossil fuel use and the reduction in CO₂ emissions required in the next 40 years. While conservation is doing its share, the evidence I've seen suggests that there is a reasonable chance of accomplishing the rest with renewables like wind, solar, geothermal, sensible biofuels that don't compete with food production and that actually deliver more energy than is used to produce them, and perhaps some technologies yet to be discovered. Nuclear power plants take a long time to bring on line; given their dangers, we're better off using that same lead time in a Marshall-plan-like program to develop the other, safer alternatives.⁷ There is also an obvious need for a massive technology transfer, to ensure that the economic development that takes place in poor countries is based on the most efficient and sustainable energy forms. This last seems both economically and politically feasible.

On the political side, it's plausible that the poor countries would accept the proposal just outlined, in which the rich countries undertake a faster, steeper decline in their CO₂ emissions – and it is vanishingly unlikely that they would take on what this scheme asks of them if the rich countries do **not** accept their part of such a deal. In other words, the best chance of bringing developing countries on board for a new international climate change treaty is to lay out a clear path towards per-capita convergence in emissions and/or energy use. The reasons to do it this way are so compelling, this scheme might also have a chance of being accepted in the richer countries, to the extent that they can turn into policy some natural human concerns about the well-being of future generations – and even of our own well-being.

6. Steps toward increasing resilience among the most vulnerable

I have suggested that mitigation activities, by themselves, can be a source of economic growth, of a new kind – I'll return later to the question of whether this kind of growth can be achieved without a reduction in the flows of real goods and services enjoyed by “The 15 percent of the world's population that live in the roughly 40 high-income countries, who use about half the world's energy, produce about half the world's CO₂, and consume about half the world's goods and services.” (Baer et al 2007, p. 11.) First I want to look a little more into what it will take to adapt to climate change, and to prepare for its dangers.

⁷ “Micropower”—the cheap and efficient “cogeneration” of electricity and useful heat together in industry and buildings, plus making energy from renewable sources like the wind, the sun, the earth and small hydropower—emits little or no carbon and is sweeping the market. Micropower, mostly from private power providers but also many utilities, now produces a sixth of the world's total electricity (just beating nuclear power) and a third of the world's annual increase in electricity. In 2005, micropower added four times the global electricity and 11 times the capacity that nuclear added.... New nuclear plants would worsen the climate problem by saving two to 10 times less carbon per dollar, more slowly, than micropower and negawatts.”

“How to Fuel the Country While Saving the World.” *Newsweek* 2007 downloaded Feb 9 2008 at <http://www.newsweek.com/id/80938/page/1>

Activities that will make individuals, communities and societies more resilient must include a great deal of education. Even before that, they need to start with the health and nutrition interventions that will allow people to attain their potential, without being stunted by illness or malnutrition.

In 1978 the World Health Organization mounted an oral rehydration campaign to treat children suffering from previously fatal diarrhea that commonly resulted from contaminated water in poor areas, or in the aftermath of wars and natural disasters. By 1990 oral rehydration packets distributed by UNICEF were saving the lives of a million children a year. This outstanding success is an encouraging reason to believe in the promise of a new initiative, in which Doctors Without Borders is working to introduce, for children at risk from malnutrition, an equally simple, cheap, easily distributed and administered formula (known as Plumpy'nut or Plumpy'doz). Since early childhood malnutrition runs a high risk of stunting an individual's continuing physical and mental development, a major reduction in this scourge would be of great significance. This is the kind of step that is needed – but only one, early-phase step – to make vulnerable people more resilient to catastrophes.

If we could imagine such initiatives being successfully undertaken to address each of the UN's Millennium Development goals, the world would have made a good start on increasing resilience among some of the world's poorest people. At the same time large areas of the world would be well on the way to achieving the human capital that is necessary to achieve the kind of economic development (better named, by the UNDP, "human development") that can support the satisfaction of basic needs in low income countries. But that rosy, long-range view needs to be counterbalanced. There are no signs of the wealthy OECD nations being willing to contribute the less than one-half of one percent of GNP that the World Bank estimated as necessary to underwrite the rest of the Millennium Development goals.

If we stretch our minds to something more ambitious than the very modest Millennium Development Goals, we see that, in addition to the need for nutrition, health and education inputs, and affordable sources of inanimate energy to allow people in developing countries to participate in global communications and education systems, they also need transportation systems – infrastructure as well as energy – that will enable farmers and other producers to get their goods to markets. And they need huge investments in urban housing and infrastructure, to convert the exploding slums into healthy dwellings.⁸

⁸ "Some 1.1 billion people lack access to safe drinking water, 2.4 billion are affected by inadequate sanitation, and 1.4 billion have no power." (Footnote 1 in chapter 6 of World Bank, 2004.) Another commentator notes that

In Sub-Saharan Africa infrastructure investment and operations and maintenance needs are at least 12 cents a day per person, or \$44 a year—a lot given that more than half of the region lives on less than \$1 a day....

Needs for infrastructure investment are estimated to range from as much as 9 percent of GDP for low-income countries to 5.5 percent for middle-income countries, with an average of about 7.1 percent for all developing countries. (Estache, 2004, p. 7)

Those are just a few of the urgent needs that will require financial capital, as well as other inputs. The current system of global capital is one in which the wealthy owners of capital deploy it where they can expect the highest returns, and then use those returns for more wealth creation and consumption – usually not in the poorer countries where they had invested. This system can help in the development and deployment of new energy technologies, but the contribution to other development imperatives that can be expected from only the standard investment approach is much too slow. Nor can we be optimistic about these needs being achieved through government or private aid, given the record of foreign assistance, with so many sorry tales of development aid being wasted or stolen.

However, vigorous climate mitigation programs could improve the lot of the poor if they include really effective sharing of new technologies. If, as seems reasonably likely, mitigation efforts produce continued, significant reduction in the cost of turning sunlight into energy readily usable by people, then tropical areas, which have labored under many disadvantages, generally including scant access to fossil fuels, could benefit from their plentiful supplies of sunlight. We could imagine a post-carbon world, starting by the middle of this century or sooner, in which the rich world uses its wealth to maintain fairly high per capita access to the full range of energy services, with declining fossil fuel use offset by increased renewable sources, along with energy conservation. At the same time, large parts of the developing world would offset their lesser reliance on fossil fuels by rapidly growing capture of renewables, especially solar energy.

This is one way in which mitigation activities in the Third World can provide a grounding for other development achievements. The next section will suggest additional ways in which it is possible to build Third World economic progress into an effective response to the climate challenge.

7. Creating the economic incentives for energy conservation and sustainable technology development

Technology alone will not be enough to get us to the post-carbon world in time. Without very strong incentives neither the technological nor the behavioral changes will come about at nearly the speed that is essential to halt global warming at 2 degrees Celsius. In addition to moral imperatives associated with concern for the future of our children and grandchildren there is a need for price incentives.

The ideal system would be one that imposes costs – **negative incentives** – on rich producers of greenhouse gasses, while providing **positive incentives** that would simultaneously encourage the poor to stop contributing to the problem, while also helping them to rise out of poverty. The breakdown of CO₂ production into two major areas – fossil fuel combustion and forest destruction – provides a convenient, though quite approximate, way of looking toward this. We would make a good start on the combined goals of mitigation of climate change, on the one hand, and healthy economic development, on the other, if we could find a way to raise the cost of burning fossil fuels, while also making it profitable, as well as safe and possible, for people living in and near

tropical forests – some of the poorest people in the world – to protect and preserve their ecosystems. These two achievements wouldn't cover all the rich or all the poor, and there is undoubtedly a danger of hurting poor people who are in various ways dependent on fossil fuel combustion – but let's forge on and see where we can get from this start.

The two ideas economists most often raise for using prices to curb fossil fuel use are taxes and carbon trading. Taxes are readily understood: governments can simply add to what consumers pay when they fill up their cars, and electric bills can be enlarged depending on the carbon content of the energy mix that was used to generate the electricity. Carbon trading is more complicated. It is also less politically scary, since politicians have become so fearful of the word T-A-X. And, I believe, it has better potential to accomplish the two goals, of poverty alleviation and climate mitigation, that must be addressed simultaneously.

Without trying to describe in detail the kind of carbon permit trading scheme that could achieve this most effectively, a critical point to remember, in terms of bills now being discussed in Congress, is that carbon permits should not be **given**, gratis, to polluters; permits should be auctioned, and in general they should only be good for a finite period, such as one year. In each successive period, based on a well-publicized, predictable schedule, a lesser number of permits should be sold; as the supply shrinks, prices will rise, and everyone in the economy will be motivated to reduce their use of CO₂ emitting fuels.

A second critical point is that the sale of these permits will generate enormous amounts of revenue. These funds should be used to help those who will suffer most from higher energy costs. Extrapolating from a good analysis,⁹ such sales in the U.S. could easily generate enough for an annual rebate of \$600-700 for everyone in the bottom three-fifths of this country's income distribution, to compensate for the higher energy costs they will face. That would still leave large amounts available to invest in significant technology development in the U.S., as well as technology transfers to other countries.

Third, in addition to the carbon credits that are bought and sold among firms, nationally and internationally, firms could also receive credit for financing carefully monitored and verified **carbon retention** efforts in their own or other countries. Systems would be established to allow forest dwellers in Africa, or woodlot owners in Arkansas, to sell certificates of sustainable land-use practices. These are practices that do not reduce the amount of carbon stored in the area for which they are responsible; in the most favorable

⁹ Boyce and Riddle, 2008, forthcoming. For an analysis of the tax alternative, see a recent paper by Gib Metcalf: http://pdf.wri.org/Brookings-WRI_GreenTaxSwap.pdf. This scheme is on the conservative side: it would not raise enough funds to cover the other critical uses for income received from raising carbon costs, i.e., assistance to low income countries, and support for technology to make the transition to the post-carbon economy. The Boyce and Riddle analysis shares some of these deficiencies; in proposing a more politically acceptable solution, in which virtually all revenues from the sale of carbon taxes would be distributed on an equal per capita basis throughout the United States, it leaves little room for the other critical uses just mentioned.

situations, they increase carbon storage. Or a U.S. firm could get credit for installing efficient electric generating equipment in China, replacing highly polluting coal plants.

The fourth critical element in an international carbon trading scheme has to do with the question of into whose hands the receipts would flow when permits, or credits, are purchased from developing nations. To understand this it is important to recognize that the proposed scheme includes two flows of money. One is the flow into the hands of the agency (presumably government) that would sell each year's emission permits. This is what would create the huge hoard of funds mentioned above. Then, however, there is also a second wave of funds changing hands, as some firms find that they need more permits than they were allowed to purchase under the initial allotment, and seek "carbon offsets," or credits, to make up for their shortfall.

As suggested earlier, during the first decade of a "carbon cap and trade" scheme developing nations could receive permits at or slightly above their initial level of fossil fuel use, but by 2020 should be aiming for 6% annual reductions. Developing nations that participate in a scheme which allots them relatively generous quantities of permits in the early years would be able sell some of their permits to firms in industrialized nations. At the same time, rising costs of carbon-based fuels, and assistance in developing alternatives, would make it attractive to move quickly to a non-carbon path for their energy development. In this way there could be two source of funds flowing from the richer countries to the poorer: one could be firm-to-firm trade in carbon permits; the other could be the sale of credits for carbon retention (e.g., in standing forests). The second flow would in some cases go directly to the people who are living closest to the ecology-protecting resource. These funds could support the development of sustainable energy alternatives while also investing in people, institutions and infrastructure to increase their resilience.

8. Two other major considerations for the United States and the world in the 21st century

The preceding sections have focused on specific kinds of policy responses to two critical areas that must be addressed together: development needs and the climate challenge. Now, before returning to the original question, of what climate change will mean for how we live, I will widen the lens to take in two other aspects of the social/economic environment within which people of the 21st century – especially in the United States – will be facing this era of dangerous challenge.

A prevalent image of population growth which has stayed with us from the 20th century now needs to be revised. Close to 50% of the people in the world are now living in countries where birth rates are at or below replacement (Wilson and Pison, 2004). This is the new fact that has not been taken into account in popular, and many academic, analyses. Even without any of the possible mortality effects of climate chaos, there are good reasons to accept the UN's low estimate for global population, which projects that it will peak at 7.7 billion around 2050, and will decline thereafter. (The UN's median

estimate projects a 9.2 billion population by 2050.)¹⁰ Even with the lower estimate, it will be difficult to provide food, energy, education, and productive work for a billion more people than are now on Earth; many environmental groups estimate that we have already surpassed the Earth's carrying capacity. That belief is certainly valid if we imagine a world of 7-10 billion people living according to American standards of consumption. (Cf. the quotation from Diamond in section 5, above.)

It is, as far as I know, coincidental that the present century, in which we reap the whirlwind of 250 years of fossil fuel use, is also the century in which 250-year long demographic trends will be reversed. In the largest view, this coincidence is probably very fortunate. It will, however, pose some additional challenges to economic functioning as well as to social and cultural developments.

Around the world medical, sanitary, and dietary improvements, as well as reduced physical wear and tear from arduous physical labor and exposure to weather extremes, has caused a dramatic rise in longevity over the last two centuries. This, combined with lower birth rates, results in a rising proportion of older people. By 2030 "nearly half of Western Europe's population will be over age 50, with a life expectancy at 50 of another 40 years."¹¹ Such projections assume, of course, that the advances in overall health that have occurred over the last two centuries will not be rolled back. If life expectancies continue to rise, or are at least do not follow Russia's lead into decline, while birth rates increasingly fall below the replacement level, these projections will be at least roughly accurate.¹² Where development economists and policy makers formerly focused on the

¹⁰ Overall, the UN projections have proven close to reality as long as growth was high, but have been slow in recognizing declining birth rates, and resistant to consider the possibility of a demographic "fifth stage" of population decline. In the early 1990s David Seckler discovered that when UN statisticians noted a fertility rate below replacement level they nevertheless based their projections on a "normalized" fertility rate of 2.1% – "because lower rates are not sustainable." (Reported by Seckler in a conversation with Neva Goodwin, 1993.) He circulated several of his papers on this subject, contending that the UN should abandon this practice and that the UN low variant was the best estimate. Recognition of the possibility of continuing below-replacement rates finally prevailed, and those watching population projections observed a sudden, dramatic drop in UN projections for future world population levels. They continue, however, to project "low, median and high" variants wherein only the low projections fully accept the reality that nation after nation is following the trend to birthrates below the level necessary to replace the current population.

See also Wilson and Pison 2004: "Les Nations unies et les autres institutions élaborant des projections de population font l'hypothèse que la fécondité remontera dans ces pays pour y atteindre à terme le niveau de remplacement ou un niveau légèrement inférieur. Mais dans toutes les projections qu'elles ont publiées depuis un demi-siècle, les Nations unies n'ont cessé de sous-estimer l'ampleur de la baisse de la fécondité." (p 2).

¹¹ Harper, 2006, p. 20 Cf. also Aaron, 2006, p. 10.: "In no European nation did as much as 5 percent of the population reach age 65 until the middle of the nineteenth century; in none did 10 percent of the population reach age 65 until after 1930. Now, projections indicate that by the year 2050 more than 20 percent of the population will exceed age 65 in most developed nations, and in several the proportion will approach or exceed 30 percent."

¹² We cannot rule out reversals in longevity which might result from new pandemics, drug-resistant diseases multiplying faster than new drugs, continued increases in obesity and diabetes, or a reversal of the conditions of life (sanitation, diet, work conditions, etc.) that have improved human health. For now, in any case, the trend is strongly toward older populations, and this is the trend I will assume as I attempt, in the last section of this paper, to imagine life in 2075.

economic strains caused by the high youth dependency ratio in countries with a population bulge at the young end, the new concern is for the old-age dependency ratio. (This is normally defined as the number of people age 65 and over for each 100 people age 15-64.)

The aging of the world's population is not only a phenomenon of the West, or of wealthy countries. Because of its one-child policy, China's old-age dependency ratio will be larger than that of the U.S. by about 20 years from now. Pensions and medical and other support for the elderly are looming as possibly China's leading social crisis. By mid-century Italy and Japan, the two countries that now have the highest median age populations (and whose populations, along with that of Germany, have actually started declining in absolute terms), are expected to have about 70 people age 65 and over for every 100 people in the work force. The fastest-growing segment of the population is the number of people age 80 and over. In 1950 those older than 80 were a negligible portion of the population in all nations, but by 2050 this cohort is expected to make up to 9.6% of the population in Europe, 7.8% in North America, 4.5% in Asia and 5.2% in Latin America.¹³

On the positive side, the convergence in life expectancies has been one of the most outstanding features of modernity, with the age gap closing faster than the wealth gap over the last half-century. (Wilson, 2006, p. 6.) On the negative side, in less developed countries old age is especially likely to be a time of poverty and hardship. Here again the need arises for institutional advances – as well as for economic development among those now suffering from material insufficiency. Public pension systems such as those in the OECD countries are hardly to be found in most of Latin America, where fewer than 20% of older people have pensions, or in Southeast Asia (under 10%) or sub-Saharan Africa (under 5%). (World Bank, 1994.)

What does an aging population mean for the economic prospects of any country, rich or poor? For one thing, it seems likely to emphasize the trend toward increasing the expansion of the service sector (e.g., health and social services vs. primary production and industry), which is in any case occurring rapidly in most economies. That might seem like a good thing, given the increasingly evident reasons to reduce consumption of raw materials. However services are not as “dematerialised” as is sometimes imagined: consider the amount of materials that are used and thrown out in a single visit to a doctor's office.

A second implication has to do with the output of an economy in relation to its total population. Over time, it is to be expected that technological innovation will continue to raise labor productivity; nevertheless, the composition of demand, supply and output will inevitably shift as a shrinking workforce produces less output than it would otherwise, while more of a society's resources are directed to the needs of the elderly.

¹³ United Nations Population Division, 2006; Population Ageing; Table 2, page 6

The issue of declining population is relevant for most of the world, but may come last, or not at all, to the United States, as long as it remains a magnet for migrants, whose first and second generations retain high enough birth rates at least to maintain replacement fertility in this country. However, the U.S. population is aging, if not declining. This will add urgency to another set of issue that is especially relevant to the United States.

For some time environmentalists have been talking about the problem of affluent societies “living beyond their means,” for example in terms of an “ecological footprint analysis” which compares the actual geographical area that we inhabit to our dependence on crop lands, forest lands, pasture lands, marine and inland fisheries, built space, and lands producing energy. “[W]ealthier nations tend to run negative ecological balances, largely because of the high degree of correlation between affluence (expenditures) and fossil fuel consumption. In regions with more modest energy consumption, on the other hand, a higher percentage of their footprint is associated with food.”¹⁴

We are not only living beyond our means in terms of what our natural environment can produce; we, as a nation, are also consuming more than our U.S. economic system actually produces. This shows up in three important kinds of deficits: the nation’s trade deficit, the U.S. government budget deficit, and excessive spending by U.S. households.

The United States spends an amount equal to 17 percent of GDP on imports, but earns from its exports an amount equal to a bit less than 11 percent of GDP. Thus imports are about 55 percent larger than exports. This trade deficit makes up the lion’s share of what is called the current account deficit.¹⁵ As of 2006 the U.S. current account deficit is running at an annual rate of \$811 billion, or about 6% percent of GDP. This

represents well over 1 percent of global GDP and absorbs close to two-thirds of the cumulative current account surpluses of all the world’s surplus countries. All of these figures are without precedent. The United States has never run such large current account deficits and no single nation’s deficit has ever bulked nearly as large relative to the global economy. At a minimum, such a unique imbalance deserves careful scrutiny. (Summers, 2004, p. 3)

We finance the current account deficit in, essentially, two ways: borrowing from other countries, and selling them our assets. In years to come this deficit will be further magnified by the fact that foreign parties have purchased U.S. bonds as well as ownership shares in firms located in the U.S., since interest and profits paid to the foreign holders of these assets become further outflows of funds from the U.S. current account.

¹⁴ Redefining Progress, p. 9 This paper continues:

“The five nations with the largest per capita ecological deficits (negative ecological balances) are the United Arab Emirates (-213), Kuwait (-146), the United States (-89), Belgium & Luxembourg (-62) and Netherlands (-56). Nations with the largest per capita ecological surpluses (positive ecological balances) are Mongolia (163), Namibia (97), Gabon (96), Mauritania (68) and Papua New Guinea (65).”

¹⁵ Much smaller elements in the current account deficit include income paid to foreigners who work in the U.S., and transfers abroad, such as monies paid out in government foreign aid programs.

In addition to the trade deficit, another deficit is that run by the U.S. federal government. This deficit has grown in recent years, largely due to huge military expenditures.¹⁶ Annual deficits lead to increases in the amount of debt outstanding, which in turn also increases the draw on the treasury to meet interest payments. The cost of the wars that the country is now pursuing, along with other present obligations, is thus increasingly being left for future generations to pay.

An economic unit runs a deficit whenever its expenditures exceed its income. Besides current account deficits and government deficits, household deficits are a serious concern. A government can, theoretically, maintain a growing debt forever as long as it is not growing larger in proportion to GDP. However, U.S. GDP is increasingly dependent on consumer spending, which has swelled to over 70 percent of the total economy (up from 63% in 1980, according to Economy.com). During this same period the share of the average household's income dedicated to servicing household or personal debt increased from 11 percent to more than 14 percent (Goodman, 2008). Consumer spending grew .5% faster than income for at least the two decades up to 2007. (Levy Economics Institute, 2007, p. 17.) U.S. consumers have been borrowing to support a national habit of consumption greater than its production.

Unlike governments, individuals cannot indefinitely spend more than they have; this fact has been painfully experienced in the sub-prime housing finance crisis of 2007-8. Returning to the patterns of borrowing that were sustained over the last decade is no solution – but that appears to be the goal of those who propose responding to the current recession by a variety of domestic fiscal stimulus packages (e.g., tax rebates, lowering the Federal interest rate). Stephen B. Roach, chairman of Morgan Stanley, Asia, has commented on such proposals by noting that

Government aid is being aimed, mistakenly, at maintaining unsustainably high rates of personal consumption. Yet that's precisely what got the United States into this mess in the first place – pushing down the savings rate, fostering a huge trade deficit and stretching consumers to take on an untenable amount of debt. (“Double Bubble Trouble,” op ed in *The New York Times*, March 5, 2008; p. A23)

The aging of the population, as noted above, is one reason to question whether future generations will be – as economists so often assume – better off than the present. To be sure, the U.S. is “special,” because our debts are denominated in our own currency – the dollar – and this may hold off the day of reckoning much longer than would be the case for any other country. Nevertheless, in the half-century-long view of this paper, it seems

¹⁶ According to Joseph Stiglitz, “Because the administration actually cut taxes as we went to war, when we were already running huge deficits, this war has, effectively, been entirely financed by deficits. The national debt has increased by some \$2.5 trillion since the beginning of the war, and of this, almost \$1 trillion is due directly to the war itself... By 2017, we estimate that the national debt will have increased, just because of the war, by some \$2 trillion.” (quoted by Bob Herbert in a *New York Times* op ed, “The \$2 Trillion Nightmare,” March 4, 2008, p. A25). This estimate includes the medical costs for returning veterans.

obvious that, at minimum, foreign lenders will become increasingly reluctant to hold ever-expanding amounts of dollar-denominated investments.

If we accept a requirement to live within our means in ecological terms, and at the same time come up against barriers to increasing, or maintaining, our dangerous triple deficits – foreign, governmental, and household – aggregate U.S. consumption (household and government) will have to decline. (For ecological reasons, the decline in consumption – and production – should emphasize resource-intensive output.) The shock waves from such a transition may well so shake the economy as to cause an absolute reduction in overall GDP. This will require considerable readjustment in a world that has come to rely on the U.S. as the “consumer of last resort.” These concerns need to be integrated into the question of whether climate change will force people in the rich nations to rearrange their lives so as to make do with significantly less consumption – and whether, at the same time, it will be possible for international equity to be increased by rising levels of material needs satisfaction among the world’s poor.

9. What does climate change mean for how we live?

The renewable economy is more labor-intensive, less capital-intensive; therefore, there should be a net increase in jobs....

It's going to be a tough century. I think we're in for something of a hard landing, some socioeconomic and ecological shocks. That can bring out the best or the worst in the country. We've already seen, with Katrina, both. We've got to start talking now and creating action that brings us closer together, across these racial lines, across these class lines, so that if things do get rougher, there's a bit more social connectivity and a bit more of a spirit of cooperation. That will create the shock absorbers we're going to need. (“A Van With a Plan: An interview with Van Jones, advocate for social justice and shared green prosperity” by David Roberts, 20 Mar 2007, in the on-line magazine, *Grist*.)

Returning to the implications of climate change, specifically, for material life-styles in the richer regions of the world, I will address the initial question of this paper with reference, again, to mitigation, adaptation, and resilience.

Climate change mitigation will, I believe, require significant life-style changes; the largest question is who will be most affected by these changes. Until the energy transition is complete – maybe as long as 50 years (though some optimistically predict a much shorter time, of 10-20 years) – energy costs will be higher. That will increase the prices for those goods and services that are energy-intensive in their production or transportation. At the same time a more general recognition of ecological limits will bring about other changes in relative prices. A host of natural resources are rapidly becoming scarce in relation to the size and appetite of the human population: these include wood, fresh water, fertile farm land, and many animal and vegetable species. In addition to paying more for a variety of goods, whether as individuals or as tax-payers we will also need to support the cost of gearing up for both conservation and new

technology. This can create very large numbers of jobs, but it means that more of the nation's wealth will be allocated to these purposes.

Ambitious mitigation activities may actually increase economic growth, but even if this is not the case the benefits of mitigation are expected to significantly outweigh the costs (Stern, 2006). Mitigation will also cause dramatic shifts in where the economy puts its resources of money and human effort, as well as of materials and energy. These shifts will certainly entail some changes in the allocation of society's product – "who gets what." As will be suggested below, this is an opportunity to move toward a less unequal distribution. If this opportunity is lost, the life-style changes will largely come in terms of reductions in well-being among the poorest members of society.

Adaptation to climate disasters, after the fact, is required when a town or a city is flooded, or crops destroyed, or new diseases roar through a population of humans or domesticated animals. This represents a net loss in wealth, wherever it occurs – though the loss can be spread very unequally, with the poor usually suffering the most. The increase in medical payments, or construction work, that will show up in the national income accounts doesn't make up for the losses in lives, in income, in dwellings, and in livelihoods that follow natural disasters – or that come in the wake of the wars and conflicts that occur when too many people are in competition for too few resources. In the U.S. as well as elsewhere losses from climate disasters will continue to grow, piling further trillions of dollars onto the amounts that climate change has already cost through increased weather instability and extremes (including droughts and wildfires as well as tornadoes, hurricanes and floods¹⁷). The bottom line here is simply that disasters affecting a whole society make that society poorer.

What about when climate change emergencies occur in poorer countries? It is not so clear that the rich are immediately forced to share their losses. Our response is sometimes an outpouring of charitable dollars, and sometimes we fail dismally in our response, depending on how "charismatic" the disaster is, and how well reported. Either way, climate change has already been imposing severe losses on people throughout the world. For example, the World Health Organization estimates that climate change is already causing an additional 150,000 deaths per year and the United Nations indicates that climate change is hampering progress towards the Millennium Development Goals. (WHO, 2008; UNDP, 2008). The impacts of future climate change will fall disproportionately on developing countries as a result of geography, a heavy reliance on agriculture, and limited resources for adaptation (Stern, 2006). The rich countries may pay a little to soften these losses, after disaster has struck, but we also face as yet unknown or unimagined costs, of many kinds, from the possibility that the nightmare scenario, described earlier, could come about.

¹⁷ Average yearly hurricane losses in the U.S. have been estimated at \$1.6 billion during the period 1950-1989, rising to \$6.2 billion a year from 1989-1995. This is compared to losses of \$63 billion in the single year 2004 and \$165 billion in 2005. "Future losses from catastrophic U.S. hurricanes could rise 70-75% above current losses." (Allianz Group and the World Wildlife Fund, 2006. p. 24.) Hurricanes are, of course, only one of the damaging manifestations of climate change; and the U.S. is one of the countries that would have been expected to have been best equipped with such catastrophes.

The creation of greater resilience among the vulnerable can be understood as “pre-adaptation.” This is another way of describing economic development. If it were done effectively, with this goal in mind, it would be more successful than most past development efforts. Truly effective development assistance, committed immediately and designed to go as directly as possible to the recipients, would be a good trade-off for the costs of emergency relief that will otherwise be needed later, and for the humanitarian crises, stretching across all political borders, from which it will be difficult or impossible for the rich to insulate themselves. In the short run a program for global resilience will cost money, most of which will need to come from the wealthy OECD countries. The Millennium Development goals are a very modest start on what is required, if people in poor countries are to achieve a minimally decent level of wellbeing. Those goals do not include the technologies and markedly improved education that are needed both for wellbeing and to mitigate and prepare for, climate change, or the huge requirements for urban and transportation infrastructure.¹⁸

The depressing fact that such an effort seems hardly more likely now than it has been in past decades is somewhat offset by one encouraging possibility. Namely, that a tradable permit system, established on a global basis, could funnel large amounts of money directly into the hands of people in the Third World in the course of their transition to renewable energy sources, and also to those who are preserving natural resources related to climate change. Some of the individuals directly receiving these funds will be wealthy; others will be poor. Much progress could be achieved toward poverty alleviation and increased resilience if these funds stay in the countries that earn them, with the poor spending their income (from, e.g., forest stewardship and watershed management) on locally grown or produced products, and the wealthier energy entrepreneurs investing in the infrastructure and buildings that will be increasingly profitable to build as more of the population moves out of poverty.

To sum up where we are so far: When we experience extreme weather events, as well as pests and diseases migrating into where we live, and commercially or aesthetically important species migrating out or becoming extinct, then our lives will be poorer regardless of the appropriateness of our after-the-fact response. We will also, for the foreseeable future, be paying scarcity prices for a variety of natural resources that used to be regarded as plentiful.

It is often noted that GDP can rise because of increasing “defensive expenses,” such as rising costs of illness, or responding to climate-related land and property destruction with dikes, or rebuilding, etc., at the same time as relative prices shift. The shift I have been

¹⁸ Right now official development aid from the OECD countries is averaging around 0.3% of GDP (the UN target is 0.7% and the U.S. contribution is only 0.2%). The existing aid is clearly far too little to achieve any of the goals just cited. As a thought experiment, if the wealthy countries were actually to contribute 10% of their GDP to the poor countries this would be equivalent to raising the per-capita income in the latter from \$509 (using 2006 World Bank data) to \$1,737. This is nearly the per-capita income level in the “middle income” countries (\$2,314) such as Columbia, Peru, or Thailand. It is interesting, though perhaps a purely academic point, to note that a shift of 10% of GDP from rich to poor could, theoretically, raise the entire world to a “middle income” standard of living.

anticipating, as a necessary part of any rational response to climate change, is one in which, at least for a transition period of some decades, energy and materials will become more expensive, relative to wages. The same amount of money might flow through the economy (i.e., no reduction in GDP), but with respect to many consumer goods it would represent less purchasing power. The cost of services, unlike material goods, would rise less, to the extent that a larger portion of their cost goes to paying wages. Education might become a bargain; doctors' visits, concerts, and massages, as well as land restoration and housing insulation, would be relatively easier to pay for than food – especially meat – or snow-mobiles or refrigerators.

The topic of inequality has appeared in this paper mostly with reference to international differences in standards of living. I have suggested a somewhat hopeful image of the future in which post-carbon economic development is encouraged in the poorer nations, while the rich countries devote significant portions of their resources to energy conservation and energy transformation at home, and also assist with adaptation and resilience both at home and (to some extent) abroad.

Within-country inequalities are also of great importance, partly because of their destructive effect on the social cohesion that is important for resilience in the face of disaster; partly for the issues of psychological well-being that will be noted in the next section; and also because hard times are hardest for those who had the least to begin with. A more even distribution of a society's assets reduces that excessive hardship. Goodman (op cit) notes that "Some Americans have so much wealth that they can spend enough to fuel much of the economy. The top fifth of American earners generates half of all consumer spending." If, as I am suggesting, climate change will require a reduction in overall consumption, it seems obvious that the largest reductions should come from this segment, where there is the largest proportion of marginally (or not at all) well-being-enhancing luxuries, as compared to basic necessities and meaningful comforts.

The point just made is a partial answer to the tripartite debate that is now heating up. Various Chambers of Commerce and other conservative economic commentators in the U.S. say that nothing should be done about climate change, for fear of reducing economic growth. Some environmentalists and communitarians say that we should, in fact, embrace a reduction in economic growth, aiming for a simpler life-style in recognition of the finite world in which we live. A third, and growing, body of opinion, recognizing that the economic costs of climate change will greatly outweigh the economic costs of mitigation, has emphasized that mitigation is, in any case, not just about costs; it also represents a program, comparable to preparation for war, that can stimulate the economy. Indeed, as we head into a severe recession in the U.S., some of the best hopes for reducing its pain are to be found in the numerous city and state initiatives that are hiring people in "green" jobs such as building retrofits for energy conservation, green infrastructure, and renewable energy projects.

As in the case of the blind men and the elephant, each of these positions starts from some piece of reality. An inequality lens makes it easier to see that the conservative position is one that looks fearfully at reductions in economic growth which are likely to affect some

major areas for traditional investing – a significant source of income for the top 20% of earners to whom Goodman referred. Environmentalists and communitarians embrace such change as a possible path toward lives that focus on the pleasures of relationships and a reversal of humanity's assaults on nature. The pro-mitigation economists and policy makers see a possibility for better work options for the people who are now losing jobs in auto manufacturing and other rust belt industries. These seismic shifts can create opportunities for broader changes toward a more equal society.

I have suggested ways in which the rich countries might choose to support economic development and energy transition in the poorer nations, but these intentional acts are not, as far as I can see, what will make the most difference to the possibilities we face in our own lives. Any amounts of money we may choose to give in foreign aid or personal charity will, I believe, be dwarfed by a changing cost structure in our own economy, as energy and natural resources become more expensive. Energy will become more expensive, as it has done over the past few years, just because the global demand for oil and other fossil fuels is rising faster than the supply. If nothing intentional is done about this trend, it will simply continue until the world's economies collapse because of climate chaos wiping out cities, causing massive starvation, death by disease, and, very likely, fueling the havoc of war and terrorism. That is not the scenario I have assumed in this paper. Rather I have assumed that some appropriate steps will be taken to raise the price of fossil fuel energy more steeply than will occur through market mechanisms alone. These steps can, and should, be taken in ways that will reduce spending power, especially among the more affluent in wealthy countries, while fostering economic development elsewhere.

When such a scenario is in place, an individual who has found it necessary to spend more of her money on energy conservation measures, including perhaps decreasing the space she inhabits, eating less meat, and traveling less, may find herself asking, "where has the rest of my money gone? Why is everything so much more expensive, in relation to my income?" The answers will include the following:

- Some of your money is paying wages to people working in energy conservation and green energy businesses. (Of course, if you are one of these, you may be a net beneficiary.)
- Some of the diminished purchasing power results from inflation; it is being absorbed in higher prices to energy producers or sellers, who (in the fast-approaching carbon-constrained world) must use part of your purchase price to purchase carbon permits. Energy producers and/or sellers also send part of what they get from you to firms or individuals, in this country or abroad, who have credits to sell because they are ahead of the curve in conserving energy and in preventing the release of additional greenhouse gases.
- The biggest impact, however, is that many things are more expensive because energy is a component of so much that we buy. As long as energy prices remain high – until the energy transition is complete – the relation between wages and other things will continue to go in the opposite direction from what we have experienced over the last 250 years, when human labor kept commanding a higher price (wage) relative to everything else, because progressively cheaper energy made virtually everything else cheaper.

You may or may not take some comfort from the fact that the scenario I've outlined – which is the most hopeful one I could imagine – includes some degree of convergence between the rich and poor countries of the world. It has included a partial convergence in per capita use of fossil fuel energy, so that by 2050 the much decreased per capita fossil fuel use in rich countries is only twice that in poor countries. The use of all energy sources might converge as well, if the tropical countries can benefit from their great amount of solar energy income. I've also suggested that the rich will feel squeezed by the rise in energy and other resource costs, while I have hoped that there will be enough benefit to the poor (in wealthy countries as well as around the world) from an appropriately designed carbon trading system that they will be able to build human, social and institutional capital to help protect them against climate disasters. Convergence, thus, means that the material standards of the rich will be declining in absolute terms, while the conditions for the poorest people of the world – especially, the 40% of the human population who now subsist on less than \$2.00 a day – will be rising.

I conclude that the reality of climate change, along with the increased proportion of elderly persons in virtually all countries, and the special problem for the United States of its triple deficit, will require down-shifting by the rich, one way or the other. This will be either as part of an intentional scheme that, as a side-effect, gives the poor nations some chance to catch up, or as the consequence of continuing business as usual until our choices have been very severely restricted. To suggest a positive view on how the “down-shifting by the rich” scenario might be a good thing for the rich as well as for the poor, I will offer some comments on the possibility that well-being can grow even while we buy less stuff.

10. The dissonance between growing consumption and increasing well-being; corporations as producers of the one, but not the other

Evidence from the human happiness literature strongly suggests that our current expenditures fail to take full advantage of the opportunities available to us. Roughly speaking, the problem is that we work too many hours, save too little, and spend too much of our income on goods that confer little additional satisfaction when all have more of them. (Frank, 2007, p. 103.)

The fascinating, fairly new field which calls itself hedonic psychology (also known as happiness studies) has established strong evidence for a set of propositions that to some may sound like simple common sense, but that are directly opposed to some basic assumptions in standard economics. These propositions¹⁹ include the following:

- People who have insecure access to the basic requirements for survival suffer reduced well-being, by any standard. However, for the people who live securely above poverty, the influence of wealth or consumption on their happiness is largely a relative matter. To the extent that their comparison group is their neighbors, only some people

¹⁹ See, for example Kahneman et al, 1999; Lane, 1991 and 2005; Diener et al, 1995 and 2000; and Veenhoven, 1993

can derive their happiness from superior wealth, while others must suffer from having, relatively speaking, less. On the global level, as more of the human population takes wealthy Americans as their comparison group (through, for example, TV shows), there is reason for ever-growing dissatisfaction throughout the world. However a reduction in global inequality would reduce such comparison-based dissatisfaction. (See note 20, below.)

- Individual increases in material wealth do not raise the happiness of the whole society; indeed, hedonic psychology research has produced evidence from Japan and the U.S., where the standard of living has risen greatly since the 1950s, showing no increase – if anything a decline – in the happiness of the population as a whole.²⁰
- Wealth very much beyond basic needs, when it belongs to and is spent on behalf of individuals, operates within a zero-sum game wherein success by a few creates, among the rest, hopeless wishes for emulation, and overall well-being is not increased. By contrast, wealth that belongs to, and is spent on behalf of, a whole society can be used to promote public goods such as environmental protection and restoration, to protect the well-being of future generations. For a given level of resources, more equal societies are psychologically and practically better able to cope with emergencies; moreover, if a cultural norm of equality promotes the more use of resources for public goods, less for private status consumption, they will be happier. (See Frank, 1999, 2007.)

Human well-being – the ultimate purpose of any economy – is not only tied to what people *have*, but also to how they feel about it, and what they do with it. Leisure to enjoy the riches that advanced economies have accumulated in the last century is becoming one of the most significant scarce resources; for many, well-being will be better served by more *time* than by more *products*. This gives credibility to a scenario in which some systems of production and consumption could be modified to produce less output (thereby mitigating climate change) but more well-being. As David Korten points out,

We can reallocate from military expenditures to health care and environmental rejuvenation. From investing in suburban sprawl to investing in compact communities and reclaiming forest and agricultural land. From advertising to

²⁰ Diener, et al, 1995. In contrast, recent findings by the Gallup Poll do find a continued rise in reported satisfaction as national wealth increases. Andrew Deaton interprets these findings thus:

...when asked to imagine the best and worst possible lives for themselves, points 10 and 0 on the scale, people use a *global* standard. Danes understand how bad life is in Togo and other poor places, and the Togolese, through television and newspapers, understand how good life is in Denmark or other high-income countries.

Such an interpretation is also consistent with Easterlin's conclusion that the "best possible life for you" is a shifting standard that will move upward with rising living standards. Thus, we might expect the Danes to continue to maintain an average rating of 8 as national income rises, provided they stay in the same position in the global income rankings. If this interpretation is correct, it would be an indication of how much the globalization of information has affected the perceptions of populations worldwide – because the consistently high correlation between income and satisfaction could not have existed in its absence. (Deaton, 2008.)

The differences between the Gallup findings and others may result from the different questions asked. Gallup asked people to imagine kinds of lives they might aspire to, while the usual question in hedonic psychology inquires about the individual's satisfaction with his or her life.

education. And from financial speculation to local entrepreneurship... There is potential to conserve or free up enormous social and environmental resources with sensible policies — all with the potential to improve the quality of our lives. A significant reduction in per capita energy consumption in rich countries ... would mean less commuting time, better insulated homes that require less maintenance, more organic, healthier, tastier, locally grown food, etc. (Personal communication, Feb. 6, 2008.)

As we go forward in the trials and transitions of the coming decades, a major challenge will be to devise systems that can encourage production of those goods and services that do most to enhance well-being, while taking cuts in types of production that are, from this perspective, less important. Markets have not yet shown much ability to discriminate between more and less well-being-promoting outputs. Markets, today, are dominated by corporations. A major question will be whether the corporate form, with its motives all lined up toward short-term profitability, can be revised or redesigned so that well-being is incorporated within its goals.

Corporations are examples of the many institutions that will need to be re-thought, or invented, from the most local to the fully global level. For the next half century or so, until the energy transition away from fossil fuels is complete, much attention will need to be given to creating, monitoring, and improving institutions to handle the recycling of monies from carbon emitters to the owners of the atmospheric commons who are most harmed by these emissions. A time will come when that potential source of wealth transfer will have dried up – a time much to be hoped for, because it will mean that the energy transition has been achieved.

Compared to this institutional challenge, right now redesign of the institution of the corporation may not seem so critical. However the long term success of the human race will be much endangered if corporations continue to be, as they are now, the world's most powerful group of institutions, and if their motivations continue to drive them to strive short-sightedly for economic growth as it was defined in the 20th century. That model has motivated corporations to act vigorously to blind consumers to the realities of what makes for a good life – e.g., drenching the culture with messages suggesting that all troubles can be solved by going shopping, and elevating money-dependent status to the highest cultural goal. If we want to imagine how the human race may emerge from the present time of looming crisis and danger to a more hopeful future, a critical part of this imagining will need to be a way of instilling in the most powerful institutions a clear orientation to immediate and long-term human well-being. Conversely, institutions that lack such an orientation should not retain the ability to shape human desires and the resulting culture.

11. The world of our grand- and great-grand-children

This paper has talked about a period of transition – a long period, probably 50 years or more. It is reasonable, in concluding, to pose the question: what is this a transition *to* –

where does the human race come out? I will take a long leap in imagination, to the year 2075, to suggest how the world might look at that time – supposing that both the projections and the prescriptions laced through this paper turn out to be pretty close to what happens. (2075 is not, of course, the end of change; but it is as far as I can stretch.)

I will start by saying that this is going to be a very optimistic view – but will then hasten, in the next three paragraphs, to get through a partial list of the losses and tragedies that humankind and the Earth will have sustained.

Many species of other creatures will have become extinct; probably the best we can hope for (a very sad best) is that the diversity of flora and fauna will be reduced by no more than a quarter or a third. Many ecosystems will have been severely disturbed, through changing temperature, weather patterns, and the accompanying movement as well as loss of species. The 20th century saw unwelcome invasions of many transplanted species – including new parasites and diseases – into both natural areas (such as lakes, meadows, forests) and areas of human habitation. By 2075 it may be possible to feel that the human race is catching up with, and learning to protect itself from, the unwelcome new arrivals, while adjusting to the losses. Ecological change will not have ceased, but it will no longer be so shocking, and will perhaps not be so rapid.

Another category of loss will be lands and structures. A modest projection sees about a foot of sea-level rise by this time, with more on the way, because this is a process that seems likely to unfold over centuries.²¹ (The other possibility, which I will not try to encompass here, is that it will be much more abrupt, with much more sea level rise having already occurred by 2075). Shore properties, including many airports and other portions of cities, as well as the most vulnerable islands, and significant portions of some nations, will either have been lost to the ocean, or will be precariously protected by ever rising dikes, dams and levees. Assuming that the sciences have been strengthened, not weakened, by the catastrophes they tried to predict and prevent, by 2075 virtually everyone on Earth will have access to good projections of what more to expect in sea level rise, and how soon to expect it. Individuals, governments, and institutions (such as insurance) will be interacting with coastal areas based on a much more precise understanding of this kind of risk (among many other climate risks).

²¹ The loss in summer of all eight million square kilometres of Arctic sea-ice now seems inevitable, and may occur as early as 2010, a century ahead of the Intergovernmental Panel on Climate Change projections. There is already enough carbon dioxide in the Earth's atmosphere to initiate ice sheet disintegration in West Antarctica and Greenland and to ensure that sea levels will rise metres in coming decades. (Greenleap and Carbon Equity, 2008.)

The Allianz Group and the World Wildlife Fund (op cit.) make the more moderate (but not necessarily more correct) projection of global sea level rise increasing “by a minimum average of 0.28 m in this century”. They add that

Even small amounts of sea level rise contribute to increasingly dangerous storm surge and more vulnerable levee systems as was seen in New Orleans in 2005. Over the next five centuries, catastrophic sea level rise of up to 6 m could inundate many U.S. coastal cities, and large portions of coastal states.

The kind of loss that is hardest to write about is what the people of 2075 will see when they look back at the deaths caused directly by extreme weather events, and indirectly by disease, war and other human violence, by hunger, and by the perils of long-distance migration. There will be a record of human misery in the middle half of the 21st century that I will not try to write of here. It will linger on as a trauma of the human species, likely even greater than the traumas of the holocaust of the 1940s and the genocidal violence that exists today.

It is too painful to try to extrapolate directly from the above about the size of the human population in 2075. However, as noted in section 8 above, there are a variety of reasons to believe that the population will not be above the UN's mid-range estimate of 9.2 billion, and may be well below that, and on the decrease.

The picture painted so far shows 2075 as a time of recovery from economic, social and psychological traumas, including a vivid awareness, on the part of all people, of the destruction that flowed from the behaviors that were based on the materialistic, commercial goals and values, and the ecological ignorance, of the 20th century. It will also be a time for adapting to changed and changing age profiles, as well as the roller-coaster changes in relative prices that began in the early part of the century, where we are now living. These realities will strongly affect human goals, values and behaviors.

A sustainable socio-economic system will be a critical goal for the people of 2075. A good example of how that must work can be suggested in an image of the system that will provide food from the land for the people of that time. Sustainably managed farms will replace some of the physical inputs of agribusiness (chemical weed and pest killers, heavy machinery) with human inputs of time, intelligence and technology (appropriately selected seeds; carefully timed, just-enough applications of water and organic fertilizer; hand-eradication of pests; excellent information on weather predictions as well as on demand conditions for various crops, etc.). The people who do such farm work will require more education than has been assumed for farm laborers of the past. For educated people the choice of farming as a profession competes with other possibilities; it will not be chosen if, as has been true during most of human history, it is a back-breaking, no-leisure-time, low-paid activity. This suggests that farm workers will be relatively better paid than they are today. Food will then become relatively more expensive, requiring considerably more than the 13% of household income that is normal in the U.S. today (but that is very low by the standards of the rest of the world).

In the most hopeful scenario I can imagine for 2075, the goal of sustainability will be accompanied by goals of equity and equality. Earlier I had mentioned the two centuries it would take for African GDP per capita to catch up with Western averages, supposing the latter did not grow. The more important point, in talking about convergence, is not a question of GDP, but is rather a matter of the throughput for which each person is responsible, as well as the amount of ecological damage attached to that throughput. Solar energy, in itself, can represent a benign form of energy throughput. Imagine solar energy being used to pump sea-water into holding areas for desalinization, which is also accomplished with solar energy. If the fresh water produced thereby is used in a

sustainable agriculture system; if the plant and animal (including human) wastes resulting from growing and eating food are returned to the soil, without introducing toxic chemicals or other elements; and if the land and water area used for all the elements of this production cycle do not remove or damage habitats needed to preserve an acceptable balance²² of humans and other species – then this describes a set of basic economic activities whose throughput has little or no negative ecological impact.

Contrast any economic activity that removes carbon-sequestering plant material without replacing it; or otherwise generates greenhouse gases; or releases toxins to diffuse in soil, water, or air; or establishes land use patterns that degrade the land's overall value to people and other creatures. These are patterns of activity that can only be replicated up to a point without tipping the ecological balance in a way that will, in the short or the long run, reduce human well-being. These are unsustainable activities. The rich populations of the world have been living lives based on patterns of economic activity that would be totally unsustainable if replicated by all the people on Earth – that are, indeed, unsustainable even within the populations now living this way.

To bring this discussion back to the year 2075: drawing on all the foregoing, my best hope for the people of that future time is that, even while they look back on a terrible period of loss and adjustment, they will be making good use of the following possibilities:

- The human population, which probably surpassed the Earth's carrying capacity sometime in the 20th century, is now declining in numbers, while its age profile is heavily weighted toward the elderly.²³ For some time yet individuals will feel that the human population is still above a sustainable level, and will respond as they have in Russia,²⁴ Japan, Italy, and many other countries where fertility rates below the level necessary to replace the existing population have emerged out of individual decisions, and often in spite of government efforts to the contrary.²⁵

²² Defining such an "acceptable balance" is one of the hardest of all tasks; I will not attempt it here, but leave the words as a place marker for a consideration that must not be ignored.

²³ If or when the populations stabilize at some level, and if life expectancy is consistently high, demographers would expect population profiles, after a few generations, to settle down in a "rectangular" pattern, in which all age cohorts are of roughly the same size.

²⁴ The Russian Federation, suffering from the special conditions of a poorly managed transition from socialism to a market economy, has a population in rapid decline; from a high of 148 million in 1990, it has fallen to 143 million today, with projections showing it sinking to 112 million by 2050 – a decline of nearly 25% in 60 years. The sharp decline in births in Russia since 1990 creates a shrunken cohort of children and youth who will find it virtually impossible – no matter what incentives the government offers – to replace in one or two generations the much larger cohort of Russians now in the workforce, as the latter retire and die. While this is a nearly unique record since the start of the demographic transition in the 18th century (the only comparison that can be made is to Ireland during the potato famine of 1845-6), we may see similar patterns, for different reasons, in other countries in the 21st century.

²⁵ Economists have long assumed that the reason for declining birthrates in some parts of the world was economic development, especially when it results in urbanization and education and job opportunities for women. These are clearly relevant, but in cases like Russia, or in many still very poor countries that are rapidly reducing their birthrates, the larger cause may be the sense of angst that comes with a conscious or unconscious awareness of the misfit between human beings and their environment.

- The destructive impacts of climate change will have hit hardest in tropical areas, small island nations, and other areas where poverty has made adaptation most difficult. At the same time, the energy transition may have been accompanied by substantial flows of resources and technology from the rich to the poor world. This, combined with humanitarian impulses and some self-interest, may have worked to reduce the world's worst inequalities in material well-being; as the rich world reduced its throughput, and its materialist aspirations, the developing countries may have found ways to improve the health, education, and material well-being of their people.
- The energy transition will have occurred quite successfully by 2075, so that energy for most uses is no longer expensive, and virtually all of the people of the world have access to energy from inanimate sources in amounts that are not much less – and may even be more – than the amounts of energy used today by people in the wealthy countries. Those who have lived through the previous period will have experienced a number of shifts in relative prices – first making energy and many material goods very expensive relative to the income people could expect to earn, then lowering the price of energy, allowing the world's many belt-tighteners to draw a deep breath. However the products of the natural world – the food, fuel, minerals, etc. whose prices, as “commodities,” plummeted throughout the 20th century – will be re-valued at levels representing the full, long-range cost of their extraction, processing and re-insertion into nature, or else their re-cycling within the production process.
- With wide recognition of the dangers of resource overuse, cheap energy will not tempt people and societies back to the profligate resource use of the 20th century. Much of the low-hanging fruit in energy and materials conservation will already have been plucked by 2050. While human ingenuity will continue to find ways to “do more with less” (to quote the 20th century visionary, Buckminster Fuller), the bottom line will be that everyone will need to accept life-styles that require reduced throughput of materials, probably of energy, and also of human labor (given population aging). Aspirations to live in the style of Americans at the beginning of the 21st century are off the table for virtually everyone – including Americans.
- The previous 50 years will have been times of tremendous institutional experimentation and reform. Some institutions for global governance will have been created. If corporations have not managed to redesign themselves to orient toward the promotion of human well-being, then the corporate form will have been replaced with other modes of production: co-operatives, local trusts and other not-for-profit organizations, and perhaps other forms not yet discovered.

These realities will inject into cultures of the year 2075 a number of critical lessons:

- To stop poisoning the oceans with run-offs from agriculture and other land uses.
- To use fresh water sparingly and wisely, so that stores of fresh water can begin to recharge, and are not polluted by human agency.
- To cherish and protect land and water ecosystems, looking forward to a gradual reversal of the process by which more and more of the surface of our planet has been taken over, and made over, for human uses.

- To value food, and the growing of it, so that, while food production will be more labor-intensive than the factory farms of the United States today (where less than 1% of the labor force is enough to feed our entire population), farm workers will be relatively better paid than they are today.
- To value the integrity of language, culture, and arts, and to resist their pollution by advertisers whose goal of selling more goods or services is not well aligned with the healthy development of human beings as individuals or as members of society.
- To revise expectations, behaviors, policies, and theories, to assist declining populations to adapt to a changing age profile. One important challenge is to discover how the elderly population can be more of an economic and cultural resource than a drain; this is desirable from an economic point of view, and also in terms of the psychological well-being (sense of meaning and purpose in life) of the elderly.
- To express the value of leisure by making it easy for those who want it to have a shorter work week, recognizing that this is a trade-off. High status will not automatically go to those who make the other choice – of less leisure and more stuff.

In section 10 of this paper I summarized some reasons to believe that we could preserve or improve levels of real well-being even while making changes in consumption patterns, with greatly reduced throughput of energy and materials flowing through the chain from extraction to production to packaging, transportation, sale, consumption, and finally to disposal. The throw-away society that developed in the 20th century externalized huge costs onto the environment and onto the people of the future. The people of 2075 will still be picking up those costs – will perhaps, less figuratively, still be picking up our trash. Not using plastics, because they end up in the oceans, ground into non-biodegradable fragments; using wood sparingly, to allow forests to regenerate; using less chemical fertilizer and more intelligence – all of these choices will come with a different kind of cost. These costs sum up to a sizeable shift in relative prices, in which many materials become more expensive. The era of expensive energy may be past or passing by 2075, but the lessons of frugality, and of how to live a better life with less work, less income, and less stuff will, I hope, remain.

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